USER MANUAL

Propeller Shaft Propulsion

AC: 2.5 / 4.0 /6.0 / 10 / 15 KW 48 VOLT

(LIQUID-COOLED - A-SYNCHRONOUS - IP66)

ELECTRIC BOAT PROPULSION SYSTEMS

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1 GENERAL INFORMATION

1.1 USE OF THIS MANUAL

This manual contains important safety and operating instructions for the safe and effective operation of the Bellmarine e-propulsion 48 Volt series.
Also maintenance instructions and possible correction of minor malfunctions of the Bellmarine AC series are included.

It is therefore obligatory that every person who works on or with a Bellmarine AC system e-propulsion is completely familiar with the contents of this manual, and that he/she carefully follows the instructions and important safety instructions contained herein.

Installation and maintenance of a Bellmarine AC system may only be performed by qualified and authorized personnel, in accordance with regulations and in compliance with the mentioned safety measures.

Keep this manual in a safe place!

1.2 VALIDITY OF THIS MANUAL

All of the specifications, provisions and instructions contained in this manual apply solely to standard versions of the Bellmarine AC series delivered by IDTechnology

For other models see other manuals available on our website: www.idtechnology.nl

1.3 GUARANTEE SPECIFICATION

IDTechnology guarantees that this unit has been built according to the legally applicable standards and specifications. Should work take place, which is not in accordance with the guidelines, instructions and specifications contained in this user manual, then damage may occur and/or the unit may no longer meet its specifications. All of these matters may mean that the guarantee becomes void.

The guarantee is limited to the costs of repair and/or replacement of the product. Costs for installation labor or shipping of the defective parts are not covered by this guarantee.

During production and before delivery, all equipment is tested and inspected. The standard warranty period is two years after purchase.

See chapter 10 for the EC Declaration of Conformity.

1.4 LIABILITY

IDTechnology can accept no liability for:

- Consequential damage due to the use of a Bellmarine AC e-propulsion system;
- Possible errors in the manuals and their consequences.

1.5 IDENTIFICATION LABEL

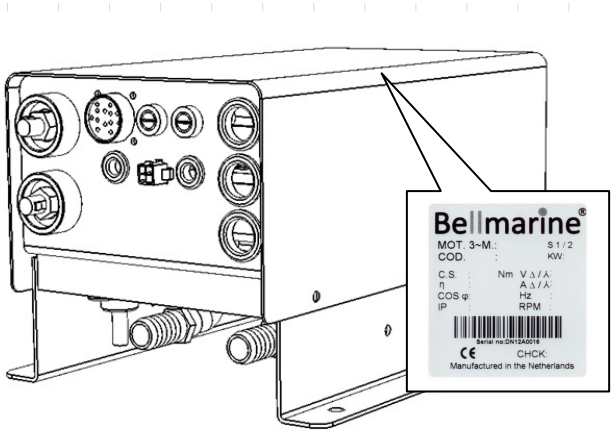


Figure 1-1: Identification label on the Bellmarine AC -34 motor controller (similar on other models 36 / 38)

The identification labels are found on the Bellmarine AC motor and motor controller (see Figure 1-1).

Important technical information required for services, maintenance and secondary delivery of parts can be derived from the identification label.

ATTENTION!
Never remove the identification labels.

2 SAFETY GUIDELINES AND MEASURES

2.1 WARNINGS AND SYMBOLS

The following warning, caution and attention symbols are used in this manual.

WARNING!
A WARNING refers to possible injury to persons if the user does not (carefully) follow the procedures.

CAUTION!
A CAUTION sign refers to possible significant damage to the equipment if the user does not (carefully) follow the procedures, restrictions and rules.

ATTENTION!
An ATTENTION sign refers to procedures, circumstances, etc. which deserve extra attention.

2.2 USE FOR INTENDED PURPOSE

A Bellmarine AC e-propulsion system may only be used for ship propulsion and according to the installation, operation and maintenance instructions of this manual.

2.3 GENERAL SAFETY AND INSTALLATION PRECAUTIONS

- Read this manual thoroughly before installing and/or using the electric components.
- Follow the assembly instructions carefully.
- Only work with the controller when the drive is switched off. It is important to switch off the power supply of the electric drive with the main switch. Remove the key and keep it with you so that nobody else can turn it back on.
- Be aware of your speed. The speed is often underestimated because of the lack of sound.
- Be alert to your surroundings, silent sail means that others can hardly hear you.

2.4 WARNING REGARDING LIFE SUPPORT APPLICATIONS

The Bellmarine AC e-propulsion system is not intended for use in any medical equipment that is intended for use as a component of any life support system unless a specific written agreement pertaining to such intended use is executed between the manufacturer and Bellmarine. Such agreement will require the equipment manufacturer either to contract additional reliability testing of the Bellmarine AC and/or to commit to undertake such testing as a part of the manufacturing process. In addition, the manufacturer must agree to indemnify and not hold Bellmarine responsible for any claims arising from the use of the Bellmarine AC e-propulsions systems in life support equipment.

2.5 WARNING REGARDING THE USE OF BATTERIES

Pay attention to the following when working with batteries:

- Someone should be within hearing range or close enough to come to your aid when you work near a lead-acid (AGM or gel) or Li-Ion battery.
- Have plenty of fresh water and soap nearby in case battery acid contacts skin, clothing or eyes.
- Wear complete eye protection and clothing protection. Avoid touching eyes while working near a battery.
- If battery acid contacts skin or clothing, wash immediately with soap and water. If acid enters the eye, immediately flood the eye with cold running water for at least 10 minutes and get medical attention immediately.
- NEVER smoke or allow a spark or flame in the vicinity of a battery or engine.
- Do not short circuit batteries, as this may result in an explosion and fire hazard! Take extra care to reduce the risk of dropping a metal tool onto a battery. It might spark or short-circuit the battery or other electrical part and it may cause an explosion.
- Remove personal metal items such as rings, bracelets, necklaces, and watches when working with a battery. A battery can produce a short-circuit current that is high enough to weld a ring or anything like it, to metal, causing a severe burn.
- NEVER charge a frozen battery.
- Excessive battery discharge and/or high charging voltages can cause serious damage to batteries. Do not exceed the recommended limits of the discharge level of your batteries.
- If it is necessary to remove a battery, always remove the grounded terminal from the battery first. Make sure all accessories are off, so as not to cause an arc.
- Be sure that the area around the battery is well ventilated while the battery is being charged. Refer to the recommendations of the battery manufacturer.
- Batteries are heavy! It may become a projectile if it is involved in an accident! Ensure adequate and secure mounting and always use suitable handling equipment for transportation.

3 HOW IT WORKS

3.1 COMPONENTS

Bellmarine AC e-propulsion system comes with the following components:

- Motor controller AC-34 / AC-36 / AC-38 (Liquid cooled)
- Asynchronous motor water cooled IP66 with pre mounted flange on shaft, motor mounting bracket, integrated temp sensor and rotary position sensor.

Option:

- Self priming pump
- Fresh water installation kit, including, water inlet / outlet / 1x Ball Valve crane ,5 meter water hose 15 mm. and cooling fresh water filter
  or
- Closed loop cool unit (Forced air cooled) including integrated pump and 5 meter water hose 15 mm.

Option:

- LCD Display (**E4**, **E7 or I-control**)
  Incl:
  Connection cable set (display, joystick, contact key, cooling pump and battery power connectors to motor controller
  Motor switch (with key)
  Main fuse and main fuse holder
  Main power switch

Option:

- Motor Flange / Propeller shaft coupler
  Shaft size Ø 25 mm.
- Motor Flange / Propeller shaft coupler
  Shaft size Ø 30 mm.

Please check the contents of the box before you start with the installation. If any of the items is missing, please contact your supplier.

Electrical installation kit: motor controller / Battery

Selfpriming pump + installation kit

Closed loop cool unit: incl. pump and fan.

3.2 MOTOR CONTROLLER AND MOTOR

The Bellmarine AC *motor controller* serves to control the speed of the asynchronous (induction) *motor* that is specifically designed for low voltage operation.
The microprocessor control allows the motor to be completely and accurately controlled and monitored. The controller software allows various properties of the drive to be set.
Some of these properties are:

- Maximum speed
- Maximum modus / economy modus
- Maximum power
- Acceleration
- Deceleration
- Boost and boost time
- Joystick performance
- Battery management

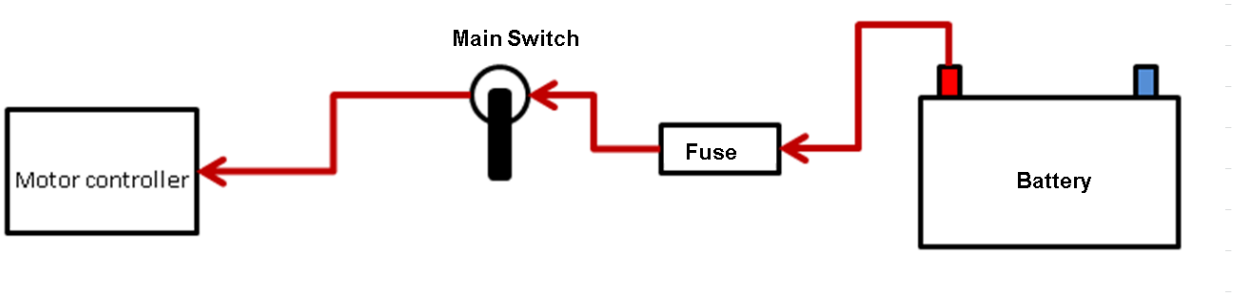
These properties and many others have already been set by IDTechnology. They can be adjusted to specific wishes by a Bellmarine dealer, or by IDTechnology after to connect the system to a PLC with Internet and using the Bellmarine interface.

3.2.1 Display (E4 or E7), Joystick and contact key

The control cable connects the motor controller with the operating instruments: the display, the joystick and the motor switch.
The joystick is not included in the system and needs to be ordered separately. Various versions are available (see chapter 9).

3.2.2 Main Switch and Main fuse

The Main fuse must be located as close as possible to the batteries, to protect the battery and power cable.
The main switch is mounted between the fuse and the motor controller in order to disconnect the batteries during emergencies and maintenance.



4 OPERATION

4.1 SWITCHING ON AND OFF

The motor is switched on by turning the key clockwise in the motor switch. The motor switch has three positions: "off", "maximum" and "economy".
Two power programs are available:

- Maximum: the full power of the motor is available.
- Economy: the maximum speed of the motor is reduced, as well as the maximum power.

It is possible to switch between the two power programs while the motor is running. Be aware that switching from “Economy” to “Maximum” will increase the speed of the motor and that of the boat instantly.

It is possible to remove the key in the "economy" (reduced power) position for safety reasons.
The system is switched off by turning the key counterclockwise to the “off” position.

4.2 POWER BOOST

Moving the Joystick / Throttle from neutral to Forward or Backwards the system will apply an extra 10% power to the motor for 8 seconds to increase acceleration and maneuverability.
Every time passing the neutral position of the joystick this power boost function will be available.

4.3 USE OF THE DISPLAY E4

After switching on the motor, the display lights up.

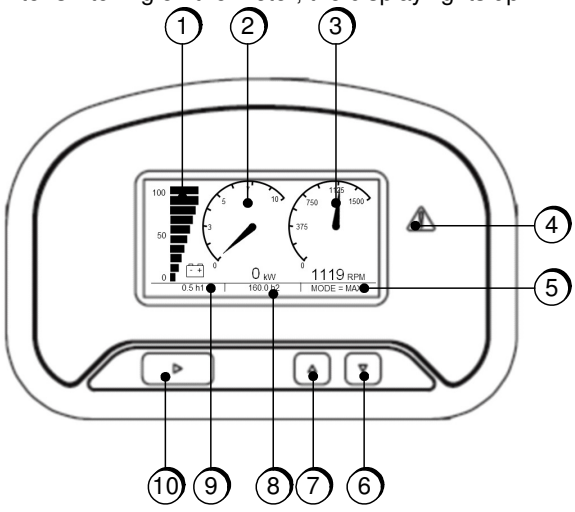


Figure 4-1: Display

4.3.1 Display buttons

6. "**Up**" menu navigation button
7. "**Down**" menu navigation button
10. "**Select**" menu button

The buttons are used for switching between two screens and navigation and control in the calibration and settings menu.

In normal operation two screens are available in the display. To toggle between the screens press the “Up” and “Down” buttons on the right [8 and 9].
Screen 1 is recognized by the image of a *battery* in the lower left corner, ***Screen 2*** is recognized by the image of a *clover leave* in the lower left corner.

4.3.2 Display fields

1. ***Screen 1*****:** Battery condition indicator, showing battery State of Charge in percentage
   Screen 2**:** Eco-meter, showing relative economy of current operation in percentage related to the speed of the boat
2. Motor power in KW
3. Speed motor / propeller
4. LED Attention triangle
5. “Economy” or “Maximum” or “Hybrid” mode
8. ***Screen 1*****:** Calculated remaining time
   Screen 2**:** blank
9. Total number of operating running hours

4.3.3 Alarm / error codes

The LED attention triangle (
Figure 4-1 [7]) flashes several times when an error occurs, followed by a short rest period. The number of times the LED flashes and the color of the LED is an indication of the malfunction.
Meaning of LED colors in case of an alarm/error:

- ***Yellow***: low battery level;
- ***Red***: alarm/error code system.
  The alarm number is shown in the display.

The display will show a large text block in the upper section with the error code displayed.

See chapter 7 for a description of the error codes.

4.3.4 Personal preferences and battery capacity

The display can be set to suit personal preferences. Both power and speed scale can be set, using the installed motor and program settings.
In the same menu also the battery capacity (C20) that is installed in the system can be set. This value is important for the battery status indication and remaining time calculation.

To change the settings:

1. Press the "**Select**" menu button [marked 10 in
2. Figure 4-1] for three seconds and the preferences menu will appear.
3. Move the slider to the setting you want to change with the "**Up**" and "**Down**" buttons on the right [8 and 9]. With the help of these buttons you can step up and down through the list of options you can change, including the battery capacity (C20 rating).
4. Confirm your choice with the "**Select**" menu button [10].
5. Repeat steps 2 and 3 for the settings you want to change.
6. Go to "**Exit**" to leave the settings menu and confirm with the "**Select**" menu button [10].
7. Press the "**Select**" menu button [10] for three seconds to leave the menu. The settings have now been changed.

4.4 USE OF THE JOYSTICK

While in the "Maximum" or "Economy" drive mode the desired power and speed can be adjusted in forward and backward direction with the joystick, by turning it over the full stroke. This happens without intermediate steps.
Figure 4-2 shows the joystick with default forward (clock-wise) and backward (counter clockwise) operation.

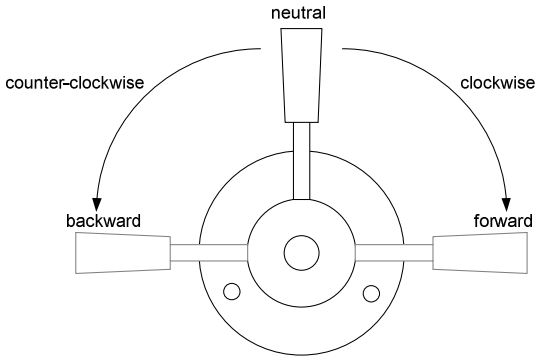


Figure 4-2: Joystick

Refer to the ordering information in chapter 9 for available types.

4.5 OTHER OPERATION FUNCTIONS

During normal operation the following functions exist and operate autonomously:

1. ***Boost function*:**
   To accommodate fast maneuvering in the two drive modes, the Bellmarine AC e-propulsion system is able to deliver an additional amount of power for a limited amount of time when changing direction by the throttle.
2. ***Sleep function*:**
   Whenever the motor is not spinning for over 60 minutes (standard setting), the Bellmarine AC e-propulsion system will switch to sleep mode limiting the amount of power use.
   To switch back to normal operation switch the system **Off** and **On** by using the motor switch.

4.6 DEPARTURE

Before departure, always check the system in Drive mode for correct functioning.

Follow these steps:

1. Disconnect the shore connection.
2. Check if the ball head crane of your cooling system is open.
3. Turn the main switch on.
4. Put the joystick in the neutral position.
5. Turn the motor switch on.
6. Check if your boat is moored well.
7. Check the battery condition.
8. Choose the power program (maximum or economy).
9. Check system carefully in forward and backward direction.

4.7 ARRIVAL

Follow these steps after arrival:

1. Put the joystick in the neutral position.
2. Check the battery condition.
3. Turn the motor switch off.
4. Turn the main switch off.
5. Close the Water intake valve of the fresh water cooling.
6. Connect the shore connection and make sure it works properly.
7. Charge your batteries properly after arrival.

5 INSTALLATION

During installation and commissioning of a Bellmarine AC e-propulsion system, the safety instructions of chapter 2 must be followed.

CAUTION!
The complete set is fully tested and provided with the correct base settings in the factory, which means that the proper motor controller always needs to be combined with the proper motor.

Notes
For a proper installation of the Bellmarine AC e-propulsion system, take note of the following:

- Check the propeller shaft for straightness.
- Use a balanced propeller that is suitable for the system on the boat.
- Provide the balanced propeller if necessary with a so called “anti-singing edge”.
- Pay attention to the position of the propeller in the shaft and the relative position of the rudder.

A number of optional items to make installation easier can be found in chapter 9.

5.1 GENERAL CONSIDERATIONS FOR A SILENT PROPELLER SHAFT SYSTEM

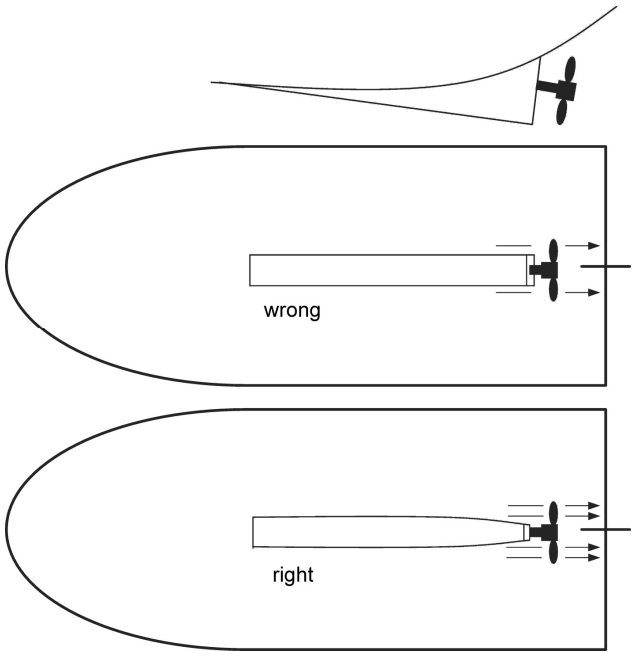


Figure 5-1: Propeller system

Before installing the propeller shaft system, the following three points must be considered to make the (electric) drive real quiet. The points are listed in order of importance.

- Inflow of the water from the propeller.
  For example, a propeller with a 2.4 KW drive moves about 280 liter water per second. The water inflow should be disrupted at a minimum and the water should flow horizontally through the propeller. If the boat has a keel from which the propeller protrudes, then the keel must be narrowed above and below the propeller shaft to get the inflow to the propeller as smooth as possible. See Figure . The view of the keel shows the difference between a straight keel and a keel that is narrowed.
- There must be enough space (at least 15% of the propeller diameter) between the propeller and the hull. The same applies when a heel is mounted that supports the rudder. When designing the heel, it is important that the inflow of water is not disrupted. A curved piece of flat steel can cause tremendous turbulence in the water causing noise and loss of efficiency.
- There must be sufficient space between the propeller and the rudder. It is an advantage that the rudder is drop shaped en is not made out of a flat plate. This drop shaped design is also called a NACA profile.

5.2 COMPONENTS

See the block diagram in chapter 3 and the wiring diagram in section 5.8.

5.3 MOTOR

A Bellmarine AC e-propulsion system is quiet and has little vibration when installed correctly. In order to achieve this, pay close attention to the placement of the motor and the entire propeller shaft system.

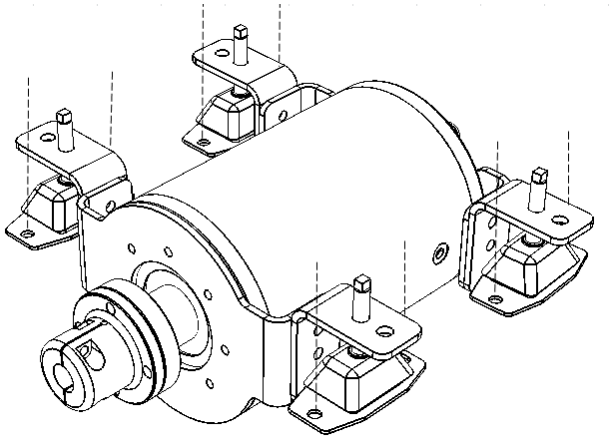


Figure 5-2: Mounting the motor

The motor must be mounted directly onto an existing foundation. The motor must be fixed by using eight bolts, as shown in Figure 5-3.

.

During installation of the motor, pay attention to the following:

- Check that all bolts are tightened after positioning the motor and propeller shaft system.
- Make sure that the motor is well protected and prepared for unforeseen circumstances like leakage.

Suggestion: place a automatic bilge pump!

Refer to chapter 8 for the motor dimensions.

5.4 MOTOR CONTROLLER

Note the following when installing the motor controller:

- The motor controller must be mounted at a dry, well-protected and accessible location in the boat.
- Take note of the length of the motor cables , install the controller as close as possible to the motor! Never install a controller near (or in the same location) as a so-called wet / open battery.
- The controller must be able to take in enough cool air, make sure there is adequate ventilation.
- Ensure that the intake opening cannot be blocked and do not cover up the outlet hole.

After the most suitable location in the boat has been determined, the controller can be mounted in place.

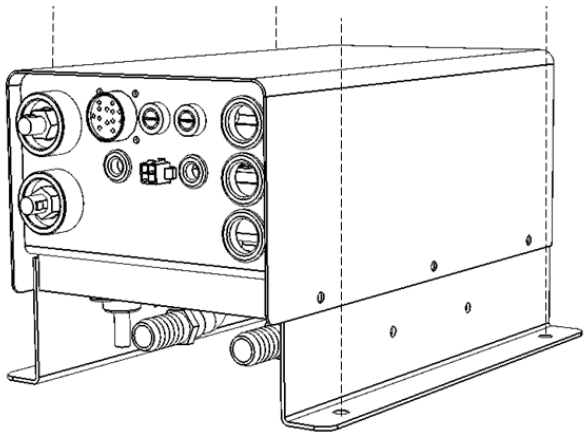


Figure 5-3: Motor controller mounting

The motor controller must be mounted by using four bolts, as shown in

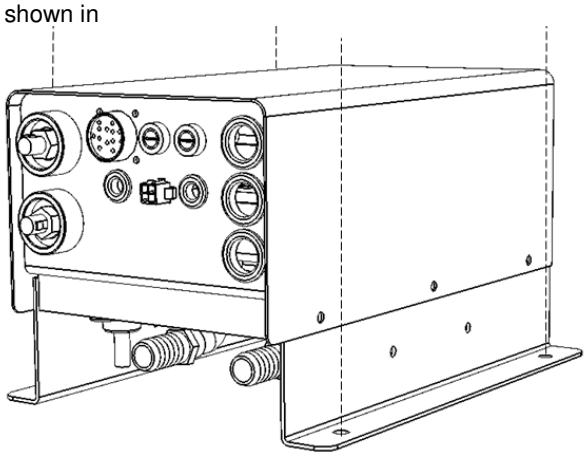


Figure 5-3.

Refer to chapter 8 for the controller dimensions.

5.5 COOLING

The Bellmarine liquid cooled e-propulsion systems can be cooled in a several way's:
1 Fresh water cooling (Only fresh water)
2 Closed loop, in combination with heat exchanger and forced air cooling.
2 Closed loop, in combination with heat exchanger and fresh water cooling

Important in the cooling system flow the motor controller must be first in line, followed by the motor.

CAUTION!
Beware of temperatures below zero, freezing can damage your system.
During freezing fill your system with coolant to protect it.
*See maintenance and service in chapter 6

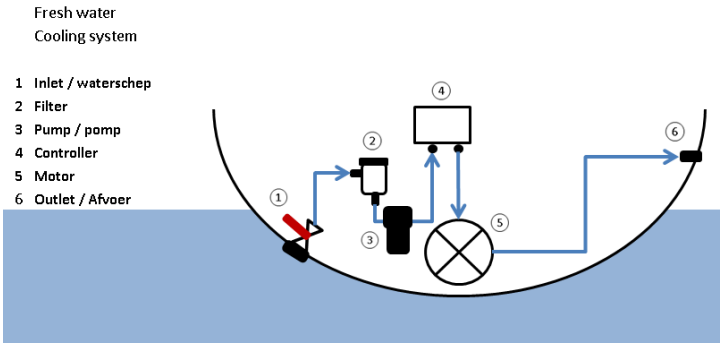


Figure 5-4: Cooling system Fresh water.

5.6 DISPLAY

The display is usually mounted on the control console of the boat. The location of the display is not critical, it is important that (rain) water does not remain on the display and can run off. Upright or slightly slanted installation is recommended. This does not apply to an indoor arrangement.
The display requires a rectangular 138 mm by 92 mm (width by height) panel cut-out.

Refer to chapter 8 for the display dimensions.

5.7 JOYSTICK

The joystick is mounted, for instance, vertically on the control console.

Note the following:

- The joystick is splash proof only. Therefore the joystick should not continuously be in contact with water. Position the joystick carefully.
- The lever has to be able to rotate freely in both directions.
- Choose the location so that the risk of turning the lever in the unwanted direction is minimal.

5.8 WIRING

Each system has the following wiring:

- Main battery power connections;
- Control cables, including preassembled connectors;
- Preassembled motor cables(2.5 and 4,2 kW), including clamp connection (U-V-W);
- Motor sensor cable, including preassembled connectors.
- Pump power cable, including preassembled connector.

The power cables for connecting the batteries to the motor controller and Motor power (UVW) cables > 4,2 kW, are not included in the delivery.
The connection of the cables is explained in the following sections. Connect the cables in the following order:

1. Connect the motor cables.
2. Connect the signal cables.
3. Connect the battery power cables.

See the block diagram in chapter 3 and the wiring diagram in Figure 5-7.

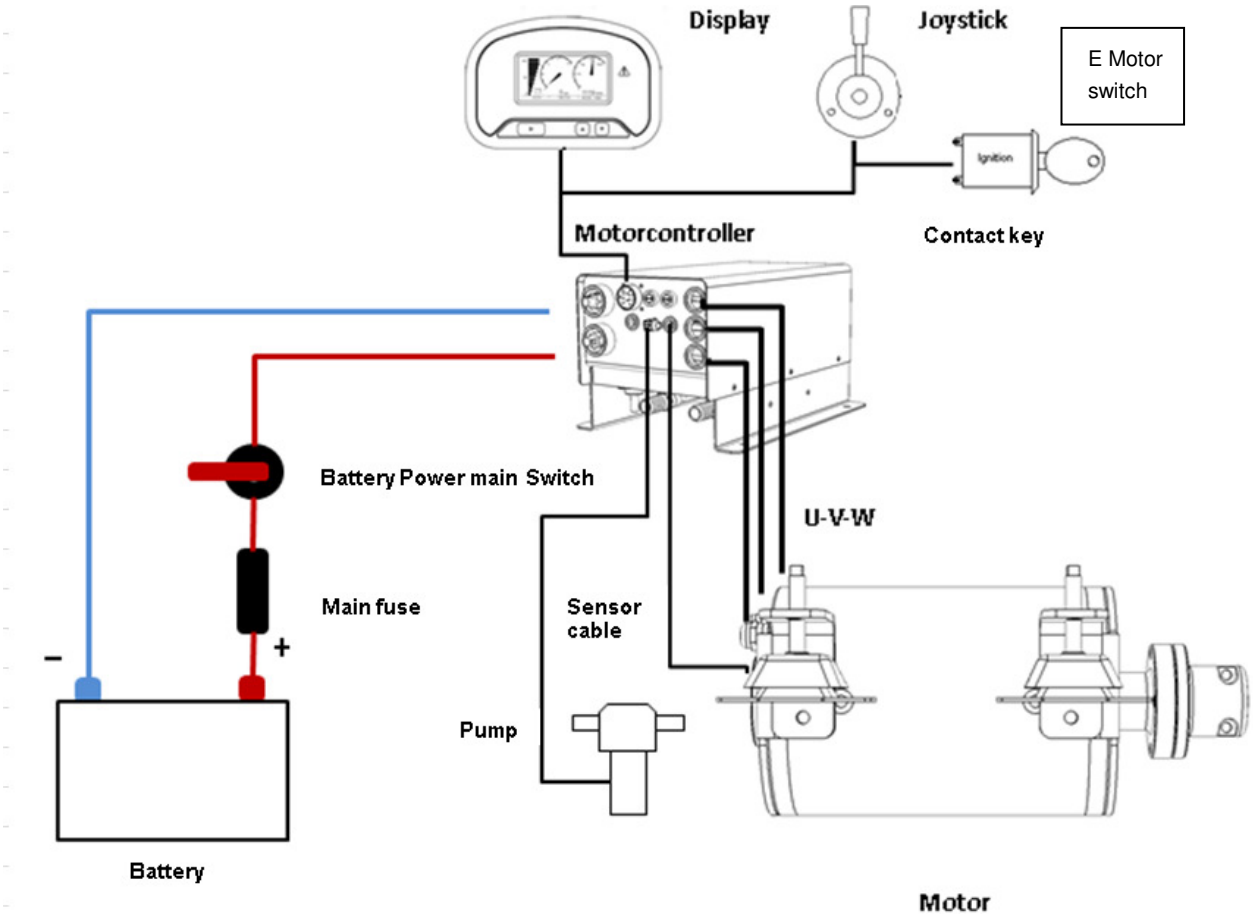


Figure 5-5: Wiring diagram (the shown motor controller is the AC-34 controller, but same connections exist on the other motor controllers AC-36 and 38)

The battery and the joystick are not included in the system. For ordering information, refer to chapter 9.

5.8.1 Motor controller connections

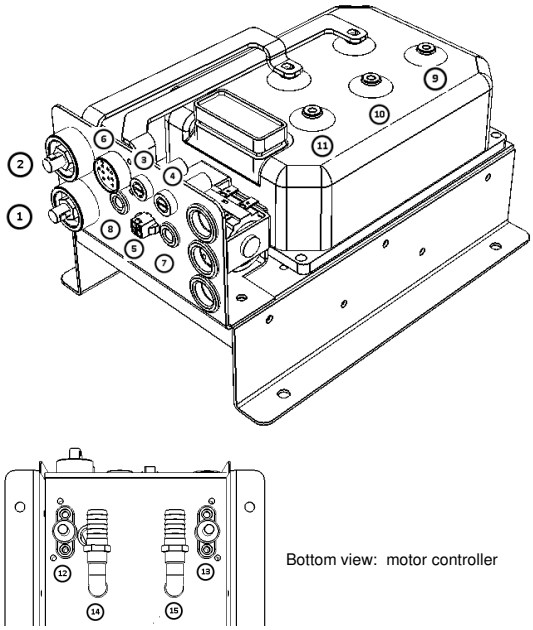


Figure 5-6: Motor controller (the shown motor controller is the AC-34 but same connections exist on the other motor controllers AC-36 and 38)

Figure 5-6 gives an overview of the connections on the motor controller.
The connections include:

1. – Pole for battery
2. + Pole for battery (incl. main switch and fuse)
3. Fuse holder - Fuse = Slow 3 A (Contact key)
4. Fuse Holder – Fuse = Slow 8 A (Pump)
5. Connection for computer
6. 12 pin connector for display, joystick and ignition
7. Motor sensor cable + Temp sensor
8. Cooling Pump power cable
9. **U** wire hole from the motor
10. **V** wire hole from the motor
11. **W** wire hole from the motor
12. Service power out: + 13,8 Volt 250 Watt
13. Service power out: - 13,8 Volt 250 Watt
14. Cooling inlet
15. Cooling outlet

5.8.2 Connection of motor cables

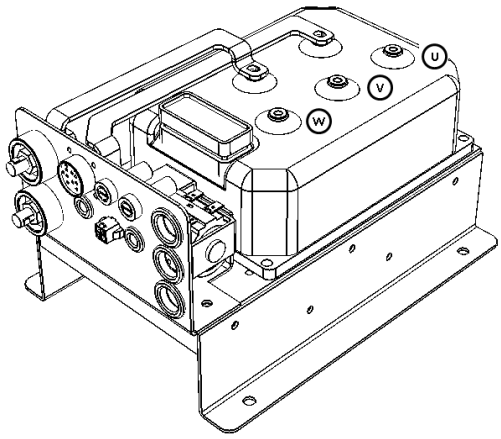


Figure 5-8: Motor controller (the shown motor controller is the AC-34 but same connections exist on the other motor controllers AC-36 and 38)

CAUTION!
Motor cables must not be as short as possible to avoid EMC!

Connections must be preserved with acid-free Vaseline.

To connect the motor cables and motor sensor cable, follow these steps:
The motor cables are already fixed to the motor.

1. Remove the metal cover from the motor controller by removing the screws marked [x], [y] and [z] in Figure , on both sides of the controller.
2. Pull the three cables through the corresponding holes at the front of the controller. Make sure that the U, V and W cables are placed in the correct location.
3. Connect the three motor cables labeled [U, V, W] onto the correspondingly marked connections on the motor controller (see Figure 5-8). Install the cables using the supplied M8 bolts and tighten them with 9.6 ± 0.9 Nm. Use a torque wrench.
4. Close the cover carefully and tighten the screws.

The motor sensor cable is already connected to the motor controller.

5. Connect the motor direction **(4P)** and temp sensor **(2P)** cable from the motor controller to the motor with the preassembled cable with 2 x IP 66 connector

5.8.3 Connection of Signal cables

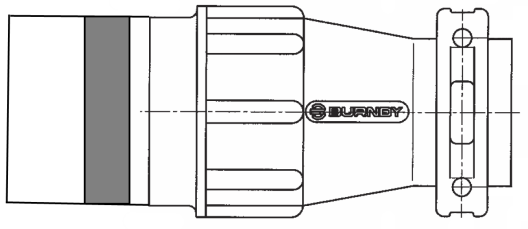


Figure 5-9: Signal cable connector 12P

Follow these steps to connect the display, joystick and motor switch to the motor controller:

1. Determine the position of the display, joystick and motor switch.
2. Bring the supplied signal cable to this position.
3. Connect the display, joystick and motor switch with the preassembled plugs.
4. Connect the 12-pin plug at the other end of the cable with the 12-pin connector that is located at the front of the motor controller.
5. Lock the plug by turning the chrome ring a quarter of a stroke.

CAUTION!
CAN-bus control signals are transferred through this cable. Therefore, never run this cable along motor power cables or 230 Volt wiring.

Secure cables properly; loose cables can eventually cause malfunctions.

5.8.4 Connection of power cables

WARNING!
Make sure that when connecting the battery and the motor controller, the fuse has been removed and the main switch is turned off.

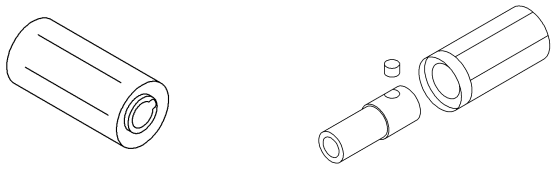


Figure 5-10: Quick connect couplings for power cable

Notice the following when connecting the cables:

- The positive terminal is clearly marked with a red mark on the motor controller.
- The main switch must be mounted at an accessible location between the fuse and the motor controller, so that the system can be disconnected from the battery in case of an emergency or in case of maintenance.

- A properly sized fuse must be placed as close as possible to the battery to ensure maximum wiring protection.
- The + cable runs from the battery to the fuse and the – cable runs from the battery to the – pole of the controller.

Specifications for connecting the motor / power cables.			
Power rating	<4,2 kW	< 8 kW	10, kW
Cable size	**≥35 mm^2**	**≥ 50 mm^2**	**≥70 mm^2**

Two quick-connect couplings are included for connection to the motor controller (see Figure 5-11).

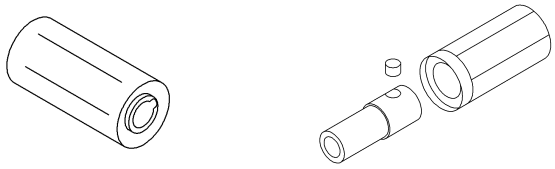


Figure 5-11: Quick connect couplings for motor controller

Follow these steps to connect the quick-connect couplings:

1. Install the couplings with care at the ends of the cables.
2. **Turn the couplings one stroke counter-clockwise. The cable is now secured and cannot get loose as a result of vibration.**
3. Place the couplings on the controller.

Refer to the manual of the battery supplier for more information about the connection and location of the battery.

Follow these steps after installation and before switching on the power:

1. Check all connections again.
2. Check the voltage of the battery.
3. When you are convinced that everything has been connected properly, turn the main switch on.

5.9 CONTROLLER CALIBRATION

The main calibration is done in the factory.
Every time the system is switched on, it will perform a self-diagnosis first. Follow these steps:

1. Put the Joystick in the neutral position.
2. Turn on the system with the motor switch.
   The display lights up and the main relay in the motor controller will close if everything is connected correctly.
3. Move the joystick forward and backward to check the system and the rotation of the propeller.
4. Check the system for unwanted noise and vibration.

CAUTION!
Steps 3 and 4 must be done carefully so that the bearings of the shaft will not be damaged in case the propeller shaft is not properly lubricated.

5.10 COMMISSIONING

The factory settings of the Bellmarine AC e-propulsion systems are optimal for most installations. For some applications however, it is desirable to change these settings. Therefore, several adjustments can be made.
If your Bellmarine AC e-propulsion system is not new, you have to take into account that previous users may have changed the settings. Let a certified installer/ dealer set the Bellmarine AC e-propulsion system to your preferences in case of doubt.

To change the controller software settings, a computer or laptop with Curtis 1314-4402 interface and software or the Curtis 1311 Handheld Programmer can be used.
See figure 5-13. This 1311 Handheld Programmer simplifies adjustments, programming, testing and diagnosing. It provides a fast and easy interface to the motor controller.
The connector for the computer or Handheld Programmer can be found on the front of the motor controller, it is marked [4] in Figure . Please refer to the Curtis 1311 Handheld manual for further operating instructions.

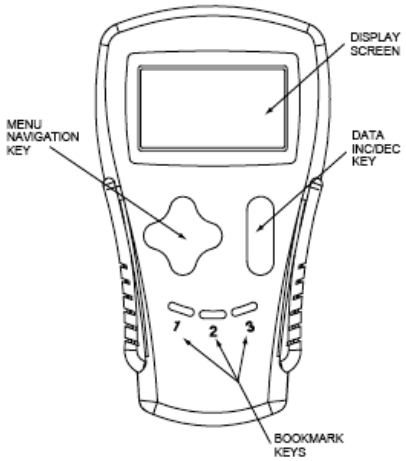


Figure 5-12: 1311 Handheld programmer

6 MAINTENANCE

6.1 PREVENTIVE MAINTENANCE

Check your whole system regularly on the following points:

- Check the bilge and motor compartment for unwanted moisture or water.
- Check the operation of the automatic bilge pump.
- Check the system for irregularities, such as abnormal noise, vibration and wear.

Keep the system always connected (even in winter storage) to the shore connection. This will keep the batteries in 100% condition and prevents self-discharging of batteries.

If the system is not going to be used for a long time and a permanent shore connection is not available, charge the batteries for 100% and remove the fuse.

Check the condition of your V-belts regularly, also after a longer period of not sailing.

6.2 MAINTENANCE

The Bellmarine liquid cooled e-propulsion systems basically don't need maintenance. However, you should be alert for moisture and salt, which can permanently damage your system.

The body of the motor and motor controller can be cleaned with a dry or slightly damp cloth. Never use water or a solvent to clean the motor or motor controller.

Always contact your dealer if you notice strange noises, vibrations or non-traceable error messages on the display.

Have your whole system checked by a qualified installer every two years. This will help keeping your system in optimal condition.

6.3 WINTERSTORAGE

The Bellmarine Liquid Cooled e-propulsion systems with an open (fresh water cooling system) must be protected in case freezing!
Temperatures below zero can damage the motor or controller.
To protect the system it is necessary to fill the system in winter time with cooling liquid!

How to protect:
Close the water inlet valve, open the fresh water Filter unit, switch on the e-propulsion system.
Disconnect the 2 pole temperature sensor on the motor and the pump will start.
Put the winter cooling fluid into the freshwater filter and make sure the complete system (motor and controller) will be filled with this.
Switch of the system, reconnect the temp sensor connection on the motor and close the fresh water filter again.

Don't forget in spring time before using the system again to open the water inlet valve !

7 TROUBLE SHOOTING

In case of a failure, the Bellmarine AC e-propulsion system display shows an error code to help you find the cause. If you cannot solve a problem with the aid of the fault finding table below, contact your local Bellmarine Service Centre. See www.idtechnology.nl

Make sure you have the article and serial number close at hand.

At the right side of the display is a LED alarm triangle (see Figure 4-1). This triangle displays the following colors in case of an alarm:

- **Yellow**: low battery level;
- **Red**: alarm/error code system.
  The number of the alarm is shown in the display, see Figure 7-1.

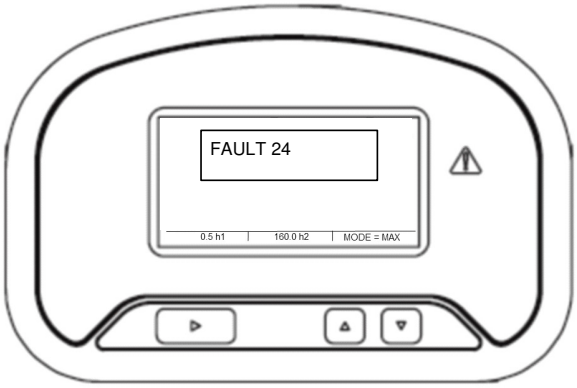


Figure 7-1: Display showing error code

The following table shows the most common errors.

Code	Error	Solution
16	Controller overheated > 95 °C	Let motor controller cool down and check the cooling of the housing.
22	Controller too hot > 85 °C	Power to motor is automatically reduced until the temperature has dropped to a safe value.
23	Low voltage warning + yellow LED signal	Battery voltage too low. Power is automatically reduced. Charge batteries as soon as possible!
24	Battery voltage too high. Motor controller cannot operate regenerative	Standard security to prevent overloading the battery. When the battery can take up current again, the regeneration will automatically start.
28	Motor temperature too high > 110 °C	Power is automatically reduced by the motor controller until the temperature has dropped to a safe value.
47	Joystick is not in neutral during switch On of the system	Put joystick in neutral.

Errors are reset with the motor switch, by turning it Off and On again.

8 TECHNICAL DATA

8.1 TECHNICAL SPECIFICATIONS

Model	**AC- liquid cooled**				
	2.5	**4,2**	**6,0**	**10**	**15**
Article number					
Battery					
Nominal battery voltage	48 V				
Battery voltage	25.2 – 60.0 V				
Minimal advised battery capacity	200 Ah	300 Ah	450 Ah	600 Ah	800 Ah
Performance					
Maximum motor drive power	< 2.5 kW (S1)	< 4,2 kW (S1)	< 6,0 kW (S1)	< 10 kW (S1)	<15 kW (S1)
Maximum motor drive speed	1450 rpm	1450 rpm	1450 rpm	1450 rpm	1450
Maximum motor drive torque	20 Nm	29 Nm	47 Nm	65 Nm	97Nm
Maximum motor regeneration power	< 2.0 kW (S1)	< 3 kW (S1)	< 4kW (S1)	<7,5 kW (S1)	10 kW (S1)
Maximum motor regeneration speed	5000 rpm	5000 rpm	5000 rpm	5000 rpm	5000 rpm
Controller					
	AC-34	**AC-34**	**AC-36**	**AC-36**	**AC-38**
Number of phases		3			
Nominal phase current	58 A	95 A	137 A	230 A	350 A
Maximum phase current	110 A	175 A	270A	430 A	500 A
PWM operating frequency	10 kHz				
Maximum encoder frequency	15 kHz				
Output frequency	0-300 Hz				
Motor					
	N30	**N30**	**N50**	**N50**	**N60**
Motor type	Asynchronous				
Sensor	Hall sensor / electronic				
Encoder pulses per rotation	64				
Communication					
CAN open, Nodes 2.0	Standard				
ID type	11 – bit				
Baud rate	< 500 Kbps				
Safety					
Under voltage	19 V				
Over voltage	63 V				
Current	Maximum allowed value is programmable				
Motor power	Maximum allowed value is programmable				
Thermal safety	Shuts down the controller when overheated				
Torque limitation	Adjustable via software				
Environment					
Temperature	-40 - 50 °C				
Protection class motor controller	IP 66				
Display upper side	IP 65				
Weight					
Motor	23 kg	25kg	55kg	59 kg	76 kg
Shaft flange (Stainless steel 316)	0.55 kg	0.5 kg	0.7 kg	0.8 kg	0.8 kg
Motor cable (U V W) standard 2.0 m	2,0 kg	2,0 kg	-	-	-
Motor controller	9.7 kg	13 kg	13 kg	13 kg	13 kg
Display	0.4 kg	0.4 kg	0.4 kg	0.4 kg	0.4 kg
Wiring assembly (controller – display)	0.7 kg	0.7 kg	0.7 kg	0.7 kg	0.7 kg
Total weight system	36,4 kg	38,4 kg	69,8 kg	74 kg	91 kg

8.2 DIMENSIONS

8.2.1 Display

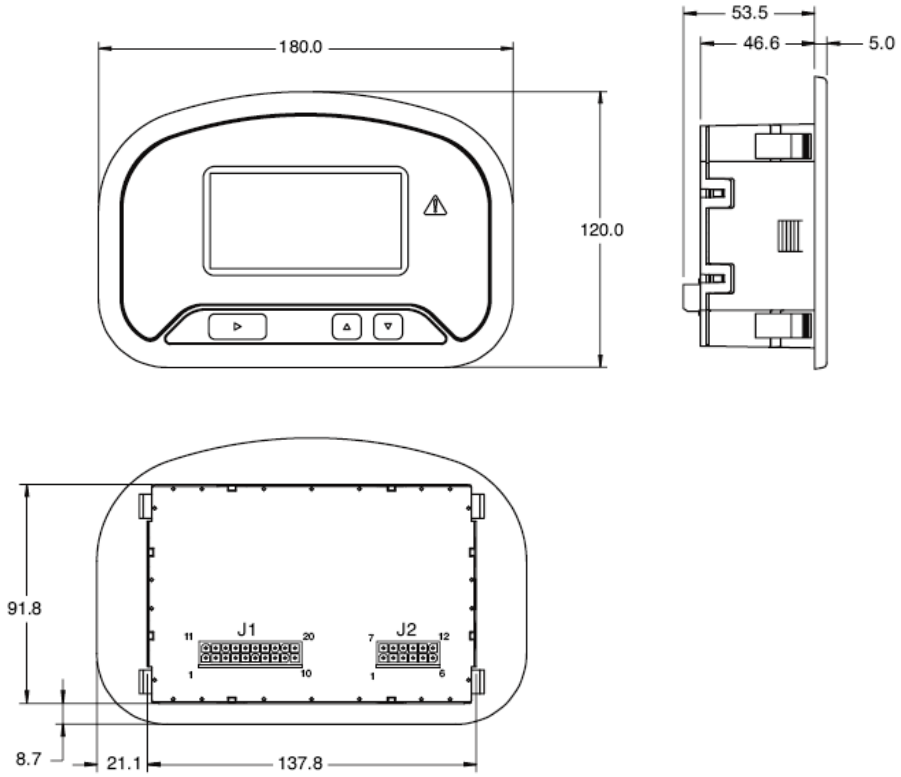
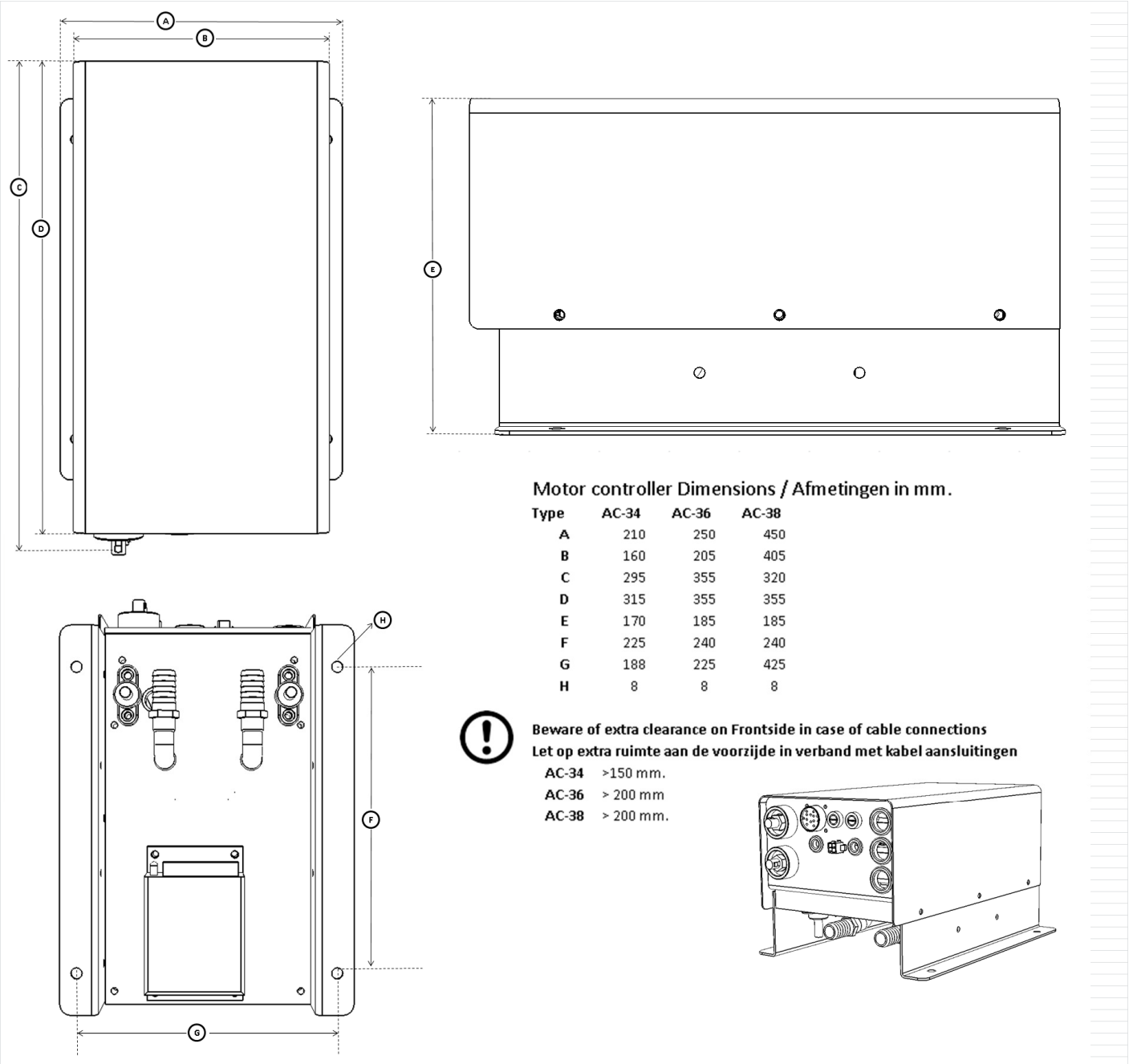


Figure 8-1: Dimensions of display in mm

Motor controller



Motor controller Dimensions / Afmetingen in mm.

Type	AC-34	AC-36	AC-38
A	210	250	450
B	160	205	405
C	295	355	320
D	315	355	355
E	170	185	185
F	225	240	240
G	188	225	425
H	8	8	8

Beware of extra clearance on Frontside in case of cable connections
Let op extra ruimte aan de voorzijde in verband met kabel aansluitingen

AC-34 >150 mm.
AC-36 > 200 mm
AC-38 > 200 mm.

Figure 8-2: Dimensions of AC-34 /36 / 38 motor controller in mm.

Asynchronous motor

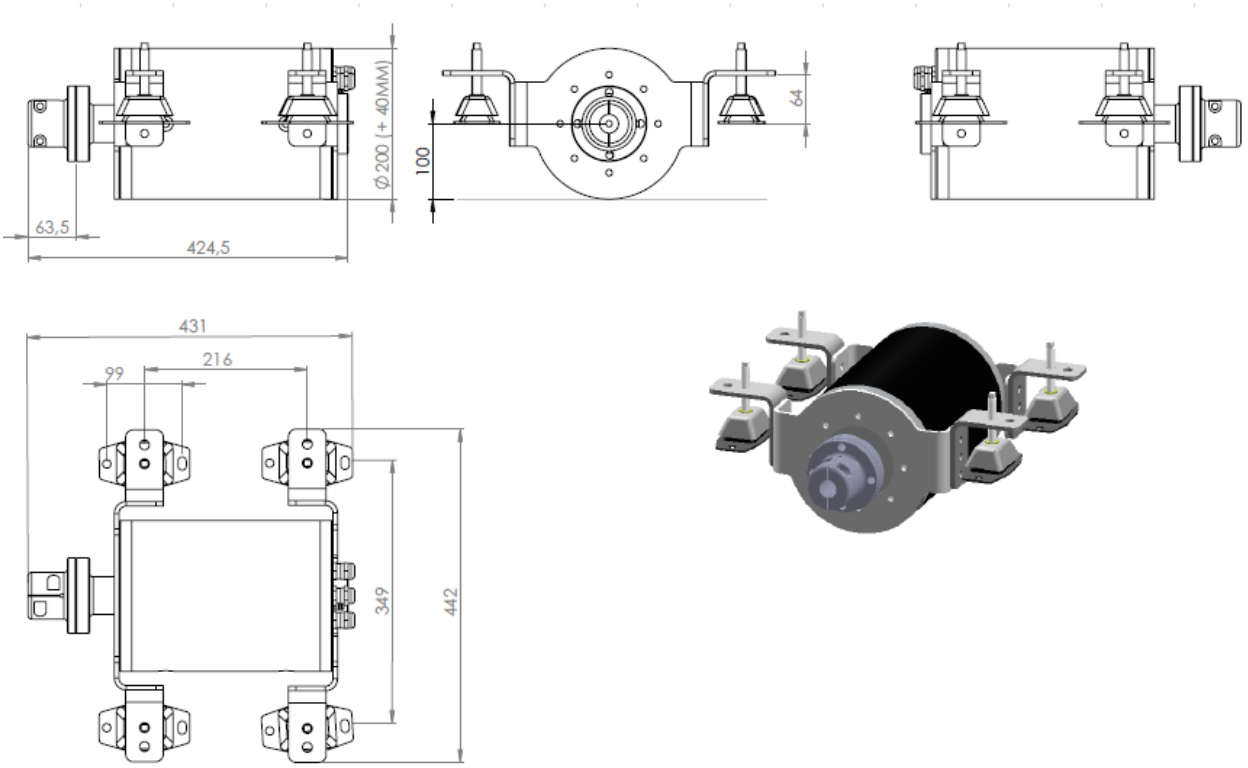


Figure 8-3: Dimensions of N-30 (2.5 / 4.2) Liquid cooled motor in mm

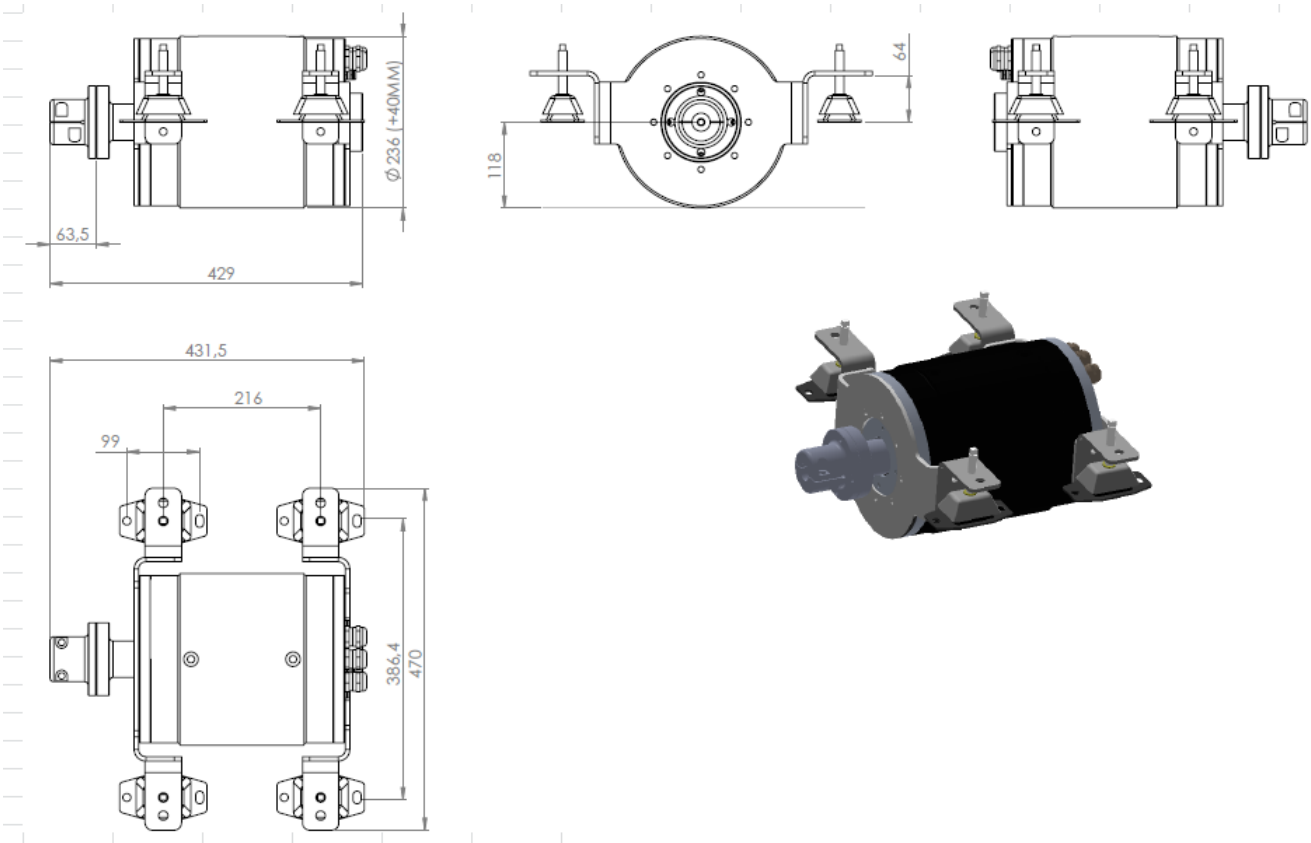


Figure 8-4: Dimensions of N50 (6.0 / 10 kW) motor in mm

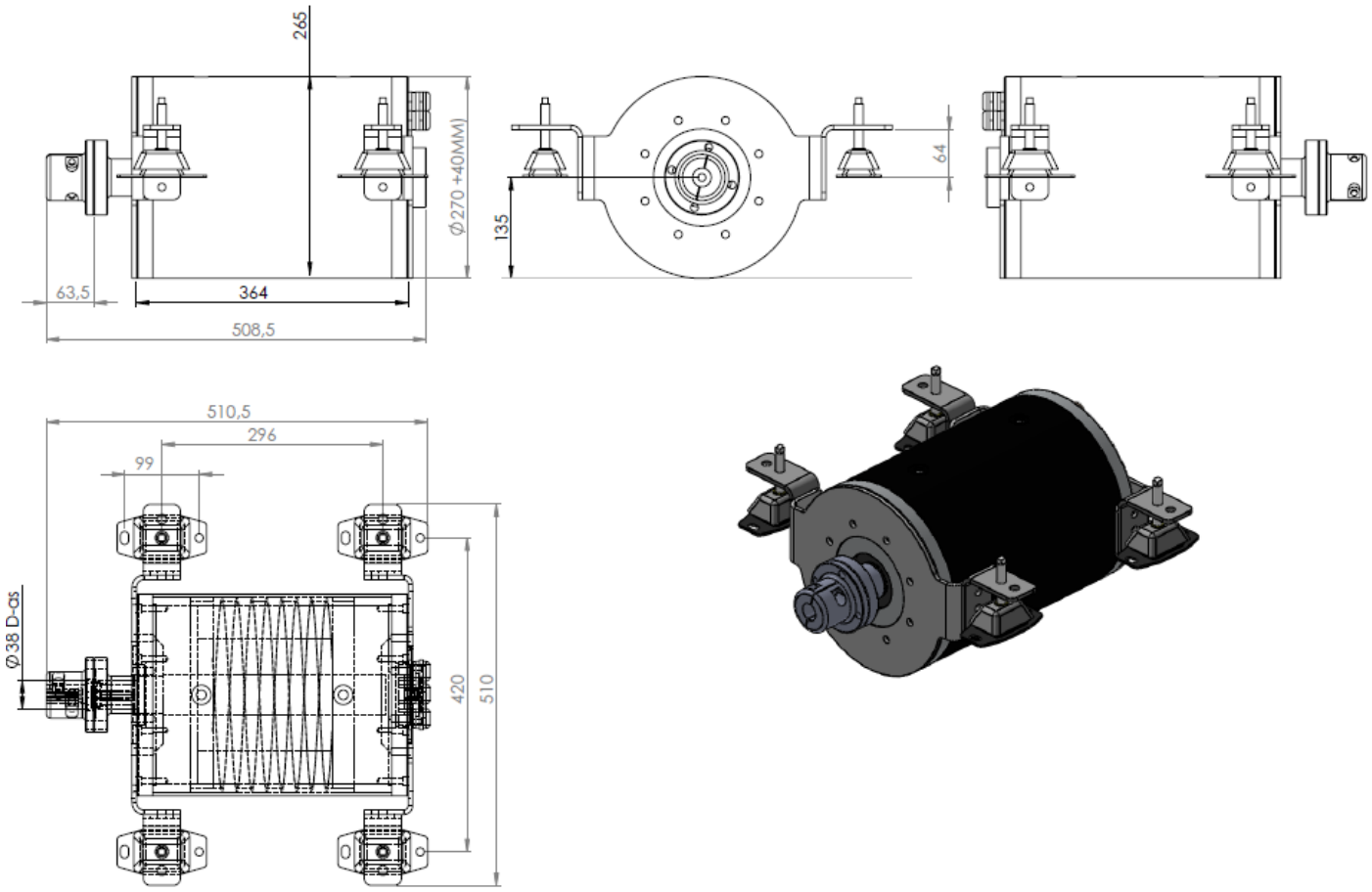


Figure 8-5: Dimensions of N60 (15 kW) motor in mm

9 ORDERING INFORMATION

9.1 ORDERING LIST

Part number	Description
100789	Self-priming pump
100799	Fresh water cool installation kit
100422	ControlMaster Casual – single version, side mount
100423	ControlMaster Sport – single version, side mount
100424	ControlMaster Sport T – single version, top mount
100542	ControlMaster Sport TD – double version, top mount
100790	ControlMaster Sport Tc– single version, top mount compact
100791	ControlMaster Sport TDc – double version, top mount compact

10 EC DECLARATION OF CONFORMITY

We,

Manufacturer IDTechnology BV / Bellmarine
Address Nobelweg 26
389BN Zeewolde
The Netherlands

Declare under our sole responsibility that the products:
Electric boat propulsion systems

Bellmarine AC- liquid Cooled 2.5 (N30)
Bellmarine AC- liquid Cooled 4.2 (N30)
Bellmarine AC- liquid Cooled 6.0 (N50)
Bellmarine AC- liquid Cooled 10.0 (N50)
Bellmarine AC-liquid Cooled 15.0 (N60)

are in conformity with the provisions of the following EC directives:

Electromagnetic Compatibility (EMC) Directive	*2004/108/EC*
Low Voltage Directive	*2006/95/EC*

The following harmonized standards have been applied:

EMC Emission standard for industrial environments	*EN 61000-6-4:2007*
EMC Immunity standard for industrial environments	*EN 61000-6-2:2005*
General Safety Information Technology Equipment	*EN 60950-1:2006*

Furthermore we hereby declare that the same products are intended to be incorporated into other machinery, and must not be put into service until the relevant machinery into which it is to be incorporated has been declared in conformity with the essential requirements of the following EC directive:

Machinery Directive	*2006/42/EC*

The following harmonized standards have been applied:

Rotating electrical machines	*EN 60034-1:2004*

Zeewolde,
22 October 2013

Marien Schoonen
CEO. IDTechnology BV (Bellmarine)